We'll be starting in just a few minutes….

Tell us…

What topics are you interested in for future Peer Exchange calls?

Please send your response to the call organizers via the question box.

Better Buildings®
U.S. DEPARTMENT OF ENERGY

Better Buildings Residential Network
Peer Exchange Call Series

All Things Ductless – Everything You Wanted to Know But Didn't Know to Ask

March 24th, 2022

U.S. DEPARTMENT OF ENERGY

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers
  - **Jennifer Cross,** National Grid
  - **Bruce Manclark,** CLEAResult
  - **Dan Perunko,** Balance Point Home Performance
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Join the Network

Member Benefits:

- Recognition in media, social media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- *4/14: Homes and Climate – Connecting the Dots*
- *4/28: What Does Electrification at Scale Look Like?*

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn & click Join

Jennifer Cross

National Grid

NYS Clean Heat
Statewide Heat Pump Program

Jennifer Cross
Senior Program Manager

nationalgrid

NYS Clean Heat Program

What is the Clean Heat Program?

- Statewide effort to support the installation of heat pump technologies for space and/or water heating to displace or replace other heating fuels.
- It is coordinated state-wide Program with NYSERDA and the other NY utilities, known as the Joint Utilities (JU) or Joint Management Committee (JMC).

- $454.3 Million state budget.
- 3.5+ Tera (Trillion) Btu Target energy savings.

NYS Clean Heat Program

National Grid's portion of the Statewide Program

- $84,398,834 budget
- 1,112,681 MMBtu target energy savings

Who is eligible for incentives? Any Electric Customer

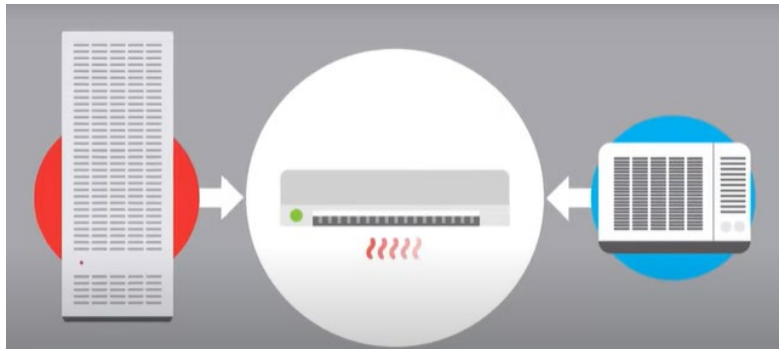
- Residential
- Multifamily
- Small Commercial
- Large Commercial
- New Construction

VISIT: https://ngrid.com/nys-cleanheat

NYS Clean Heat Program

What are Heat Pumps?

- **Heat Pumps extract heat from the air or ground outside and distribute it inside your home/building/facility. During warmer months, the process is reversed, and heat is pulled from the interior space and released outside.**



Video

What are the benefits?

- **Increased efficiency:** Heats and cools your home more efficiently than traditional HVAC systems.
- **Increased comfort:** Heat Pumps provide quiet, even heating and cooling throughout your home or building.
- **Low maintenance:** Systems last longer than conventional HVAC units and require minimal maintenance
- **Clean, healthy and safe:** No combustion of fossil fuels, no fuel storage, no emissions, and no risk of carbon monoxide fumes

NYS Clean Heat Program

What are the eligible technologies for incentives?

1. **Air Source Heat Pumps for space heating applications, including:**
    1. Cold Climate Air-to-Air Mini-Split Heat Pumps
    2. Cold Climate Air-to-Air Single Packaged Heat Pumps
    3. Air-to-Air Large Commercial Unitary heat pumps (single packaged or split system)
    4. Air Source Variable Refrigerant Flow heat pumps; and
    5. Packaged Terminal Heat Pumps
    6. Single Package Vertical Heat Pumps
2. **Ground Source Heat Pumps for space and water heating applications; and**
3. **Heat Pump Water Heaters for domestic and service water heating applications, including:**
    1. Air-to-Water HPWHs
    2. Ground Source Heat Pump Desuperheaters
    3. Dedicated Water-to-Water Heat Pump added to Ground Loop
4. **Non-Code Required Energy Recovery Ventilators (ERVs) and Heat Recovery Ventilators (HRVs) paired with eligible heat pumps**
5. **Building Envelope Upgrades paired with eligible heat pumps**

**For a detailed eligibility table please see the Program Sheet or NYS Clean Heat Program Manual.*

NYS Clean Heat Participating Contractor

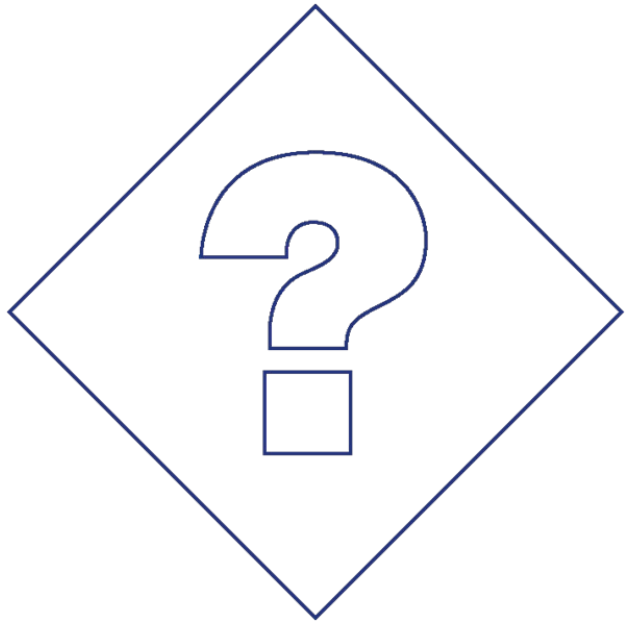
Heat Pumps must be installed by a NYS Clean Heat Participating Contractor to be eligible for a rebate.

The Participating Contractor will ensure eligible equipment is selected and submit for an incentive on behalf of the customer.

To find a Participating Contractor or to enroll as a Participating Contractor

Visit: https://saveenergy.ny.gov/NYScleanheat/

Contact Information



Jennifer Cross
Senior Program Manager
Jennifer.cross@nationalgrid.com

nationalgrid

Bruce Manclark
CLEAResult

DHP SIZING AND A FEW OTHER RANDOM THOUGHTS

Ductless Heat Pumps. Many Styles.

- Ductless
- Mini Ducted
- Full ducted systems

WHAT WE KNOW NOW

- Ductless heat pumps:
  - Reliable
  - Efficient
  - Energy saving
  - Aesthetics matter
  - Give homeowners high levels of satisfaction

Customer Benefits

ENERGY SAVINGS

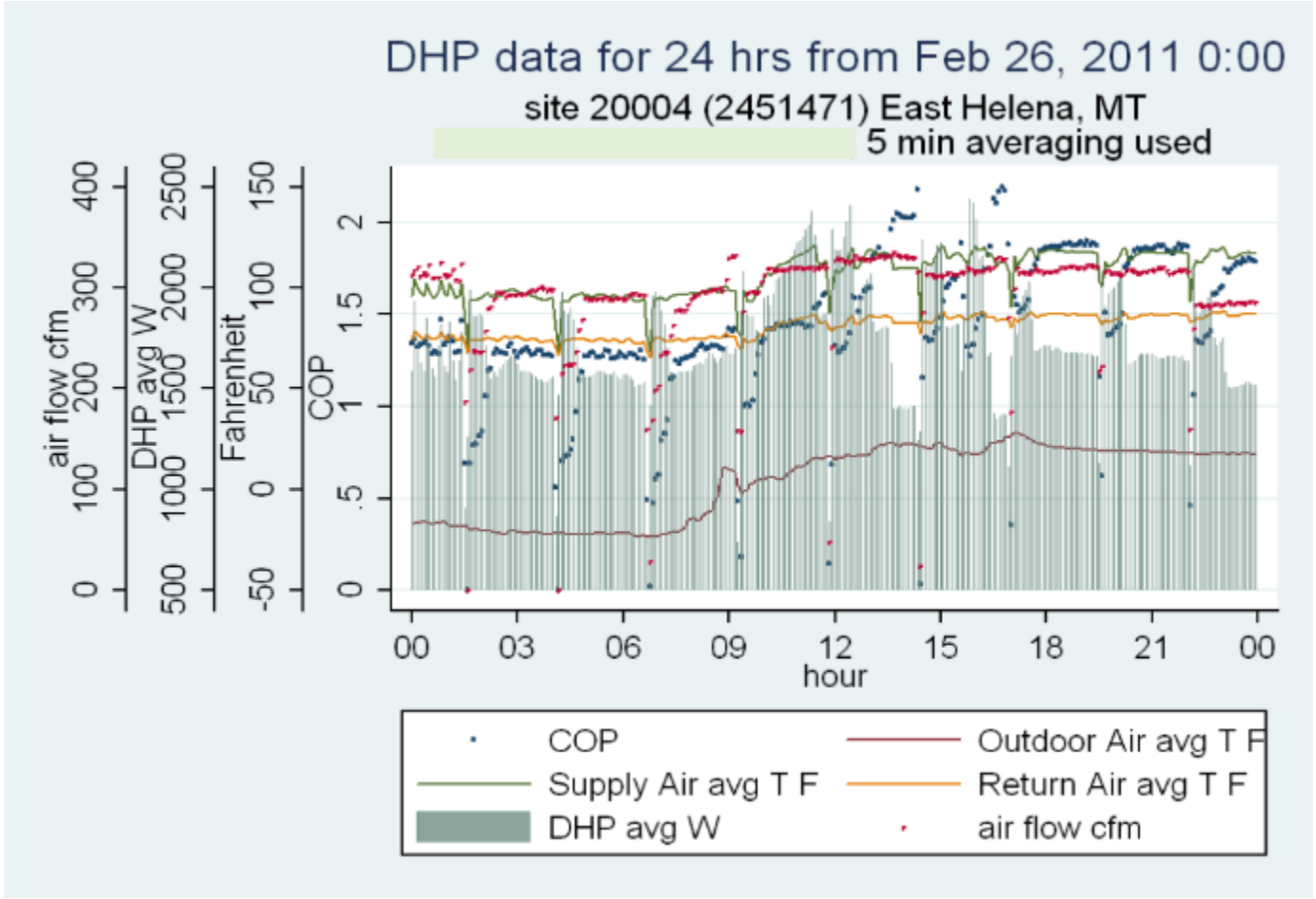
AIR-CONDITIONING

PROVIDES COMFORT, SOLVES PROBLEMS

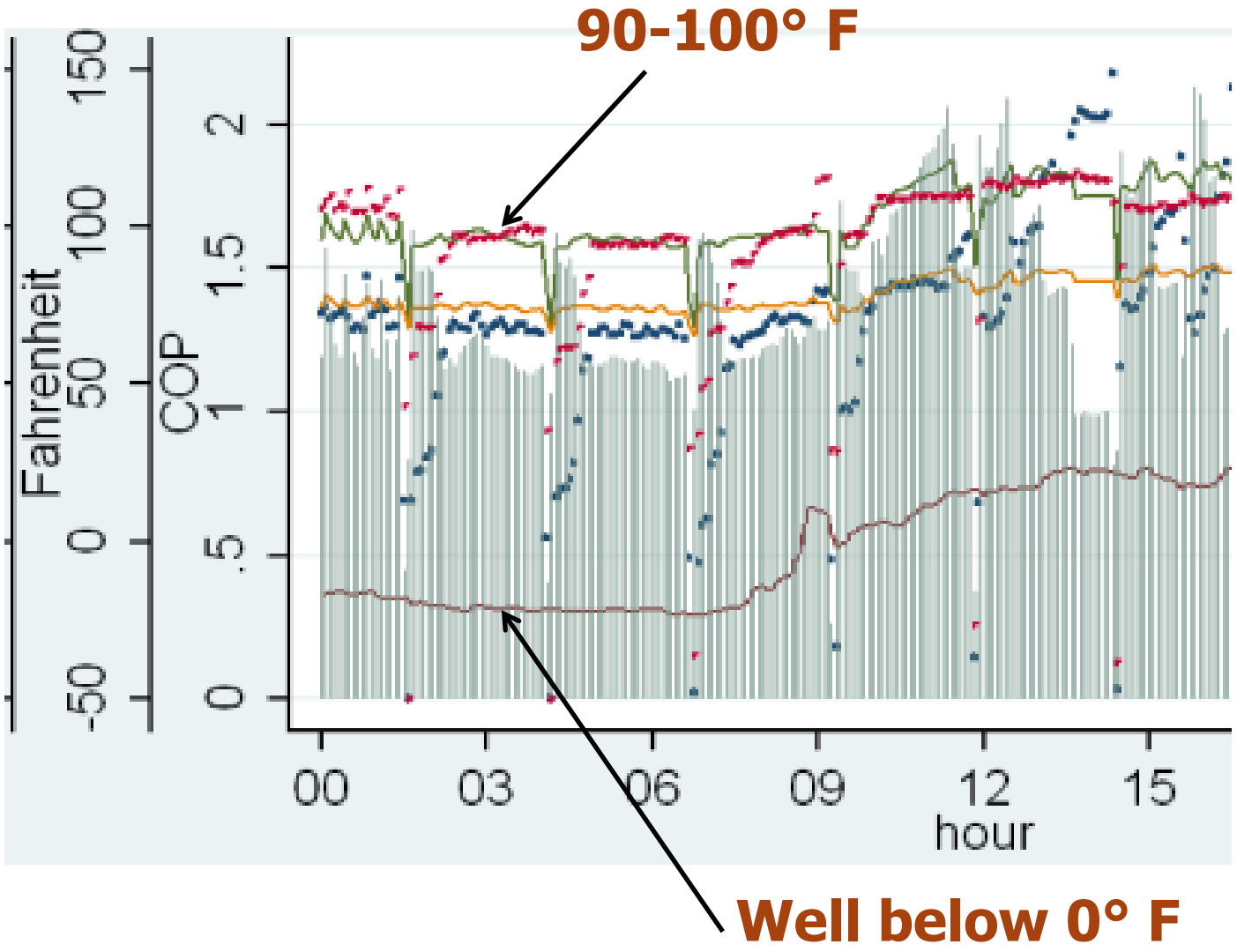
CONTROL – ZONAL HEAT – WHERE AND WHEN YOU WANT IT

NO DUCTWORK !

DHP COLD WEATHER PERFORMANCE



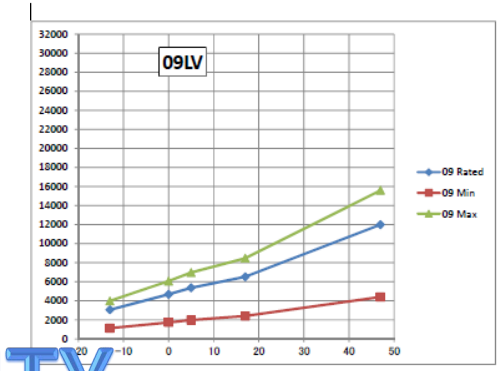
HOW HOT WOULD YOU LIKE YOUR SUPPLY AIR?



WHAT WE HAVE LEARNED

- Sizing and Selection is REALLY important!
- Placement is really important
- Homeowner education is really important
- There are BIG differences between models with same nominal size

Heating Cooling Loads Must Be Calculated



DETAILED CAPACITY MUST BE KNOWN

THE NATURE OF EQUIPMENT SELECTION

The goal of sizing HVAC equipment is to find the best match between the house and the equipment

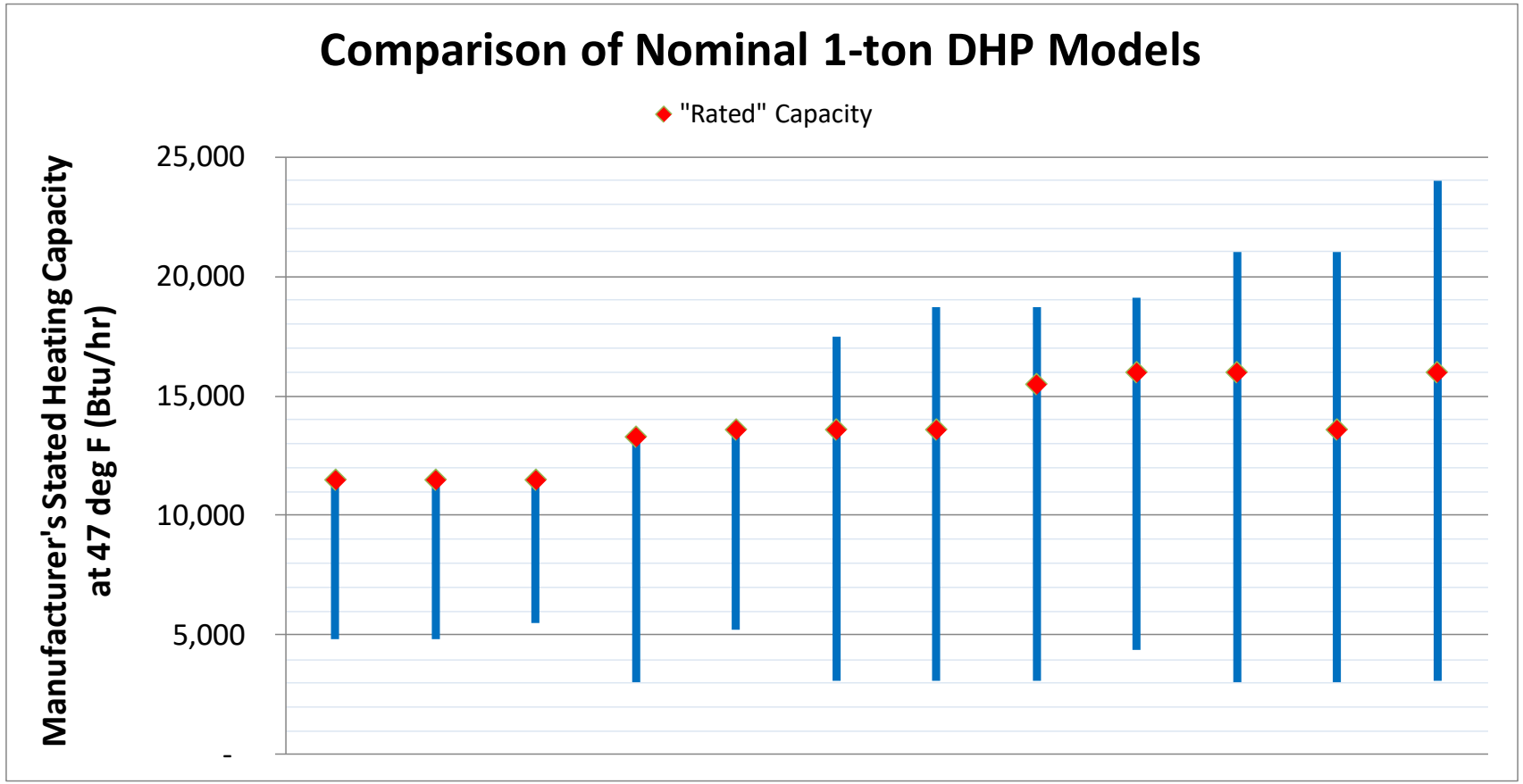
Optimal size is the best match, *or balance*, between the load of the house and the capacity of the HVAC equipment

Modern, efficient homes are creating a dichotomy in which the loads don’t match well with traditional, ducted equipment

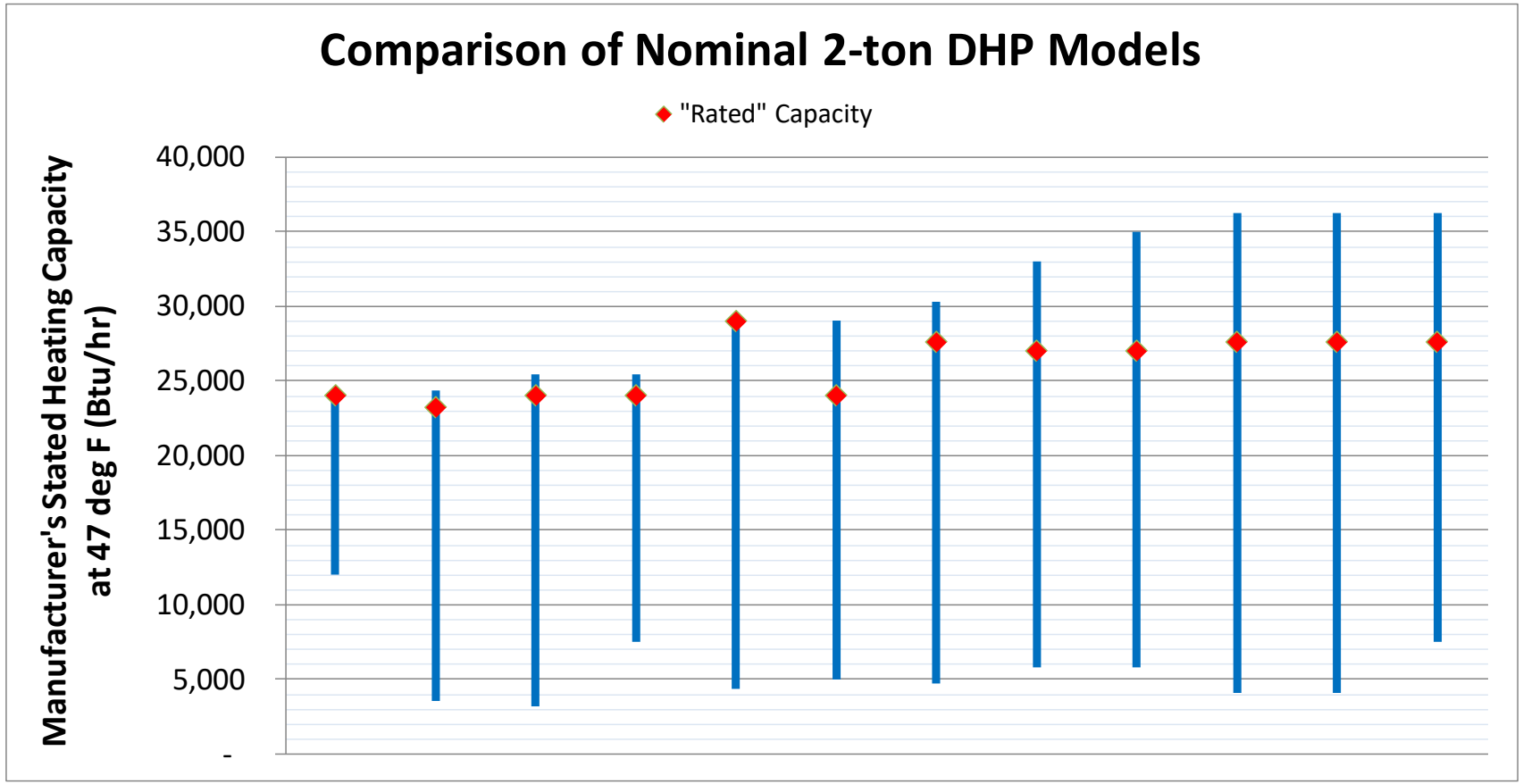
SIZING DUCTLESS HEAT PUMPS

- Size to meet the load of the zone(s) at design conditions
  - Take into account supplemental sources and overall design
- When sizing, the minimum capacity is nearly as important as the maximum capacity
  - When the house load drops below minimum capacity, performance drops from severe short-cycling
  - A look at the max/min capacity at 47° F can be an indicator of how the unit will perform in these conditions
  - We call this the unit's "turn-down ratio"
  - It varies greatly by model
- Look for a unit with at least a 4:1 ratio or higher between its maximum and minimum capacity at 47° F

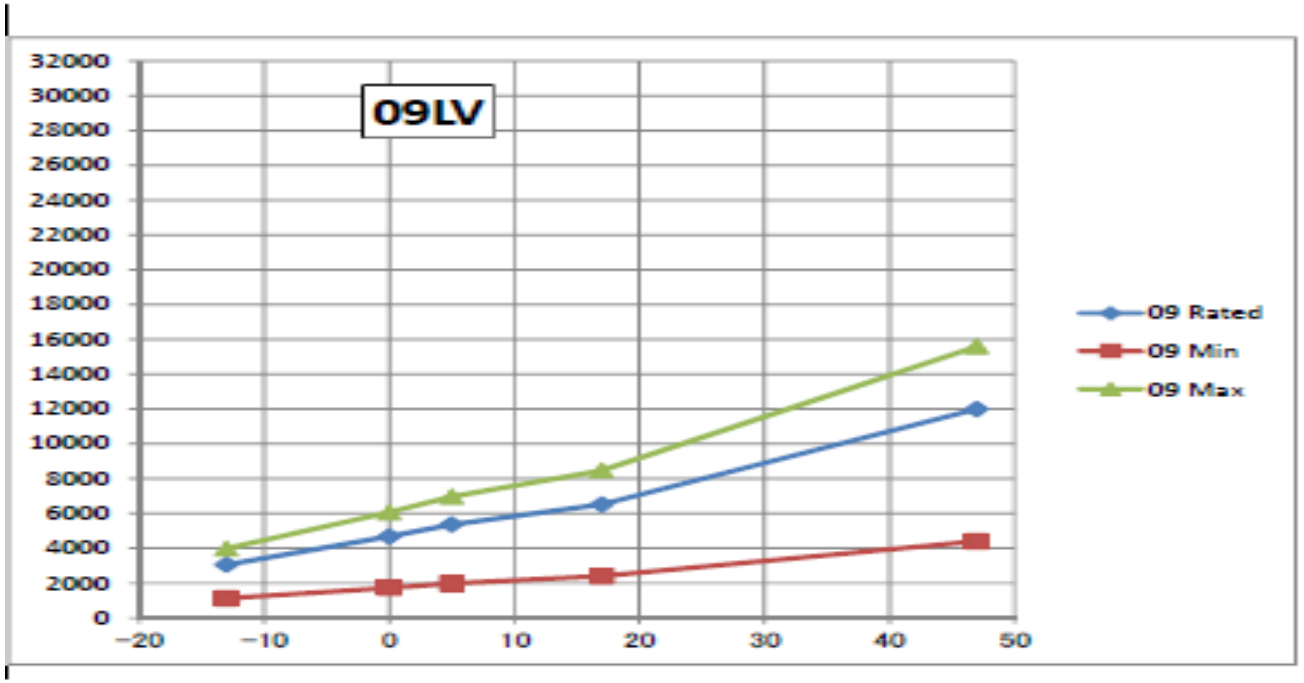
SIZING DUCTLESS HEAT PUMPS



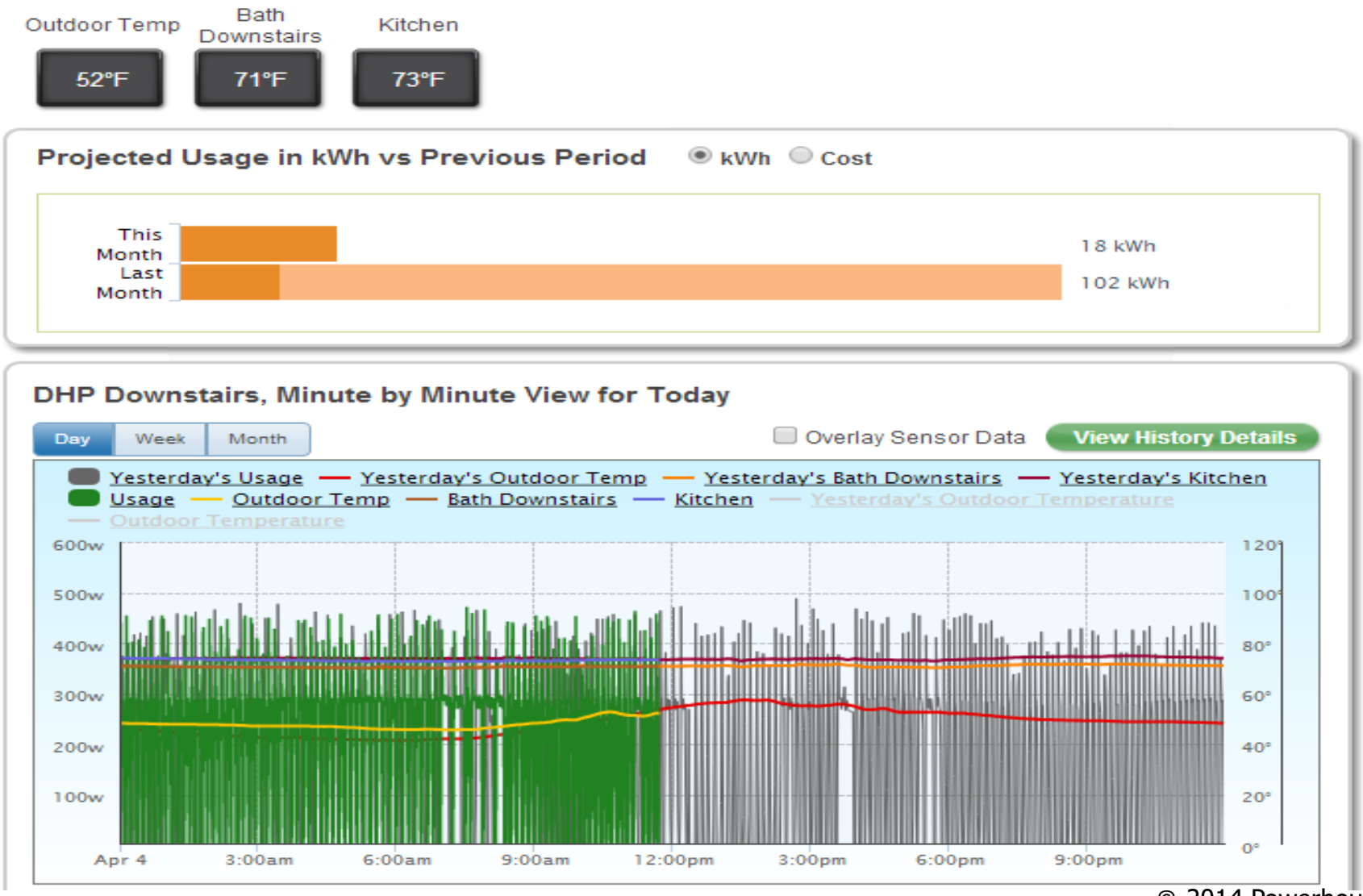
SIZING DUCTLESS HEAT PUMPS



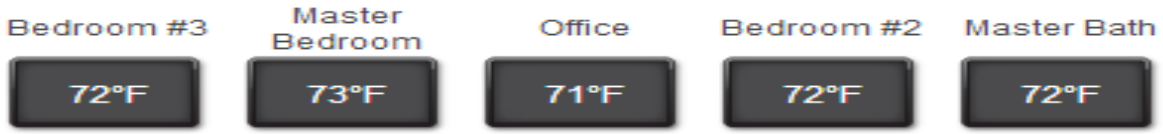
SIZING DUCTLESS HEAT PUMPS

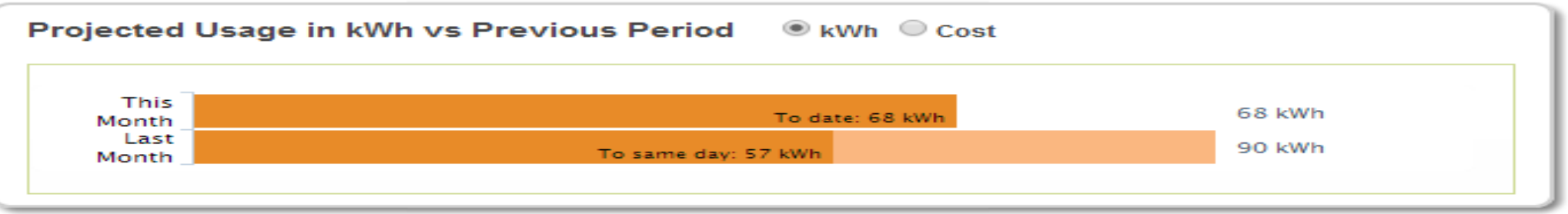


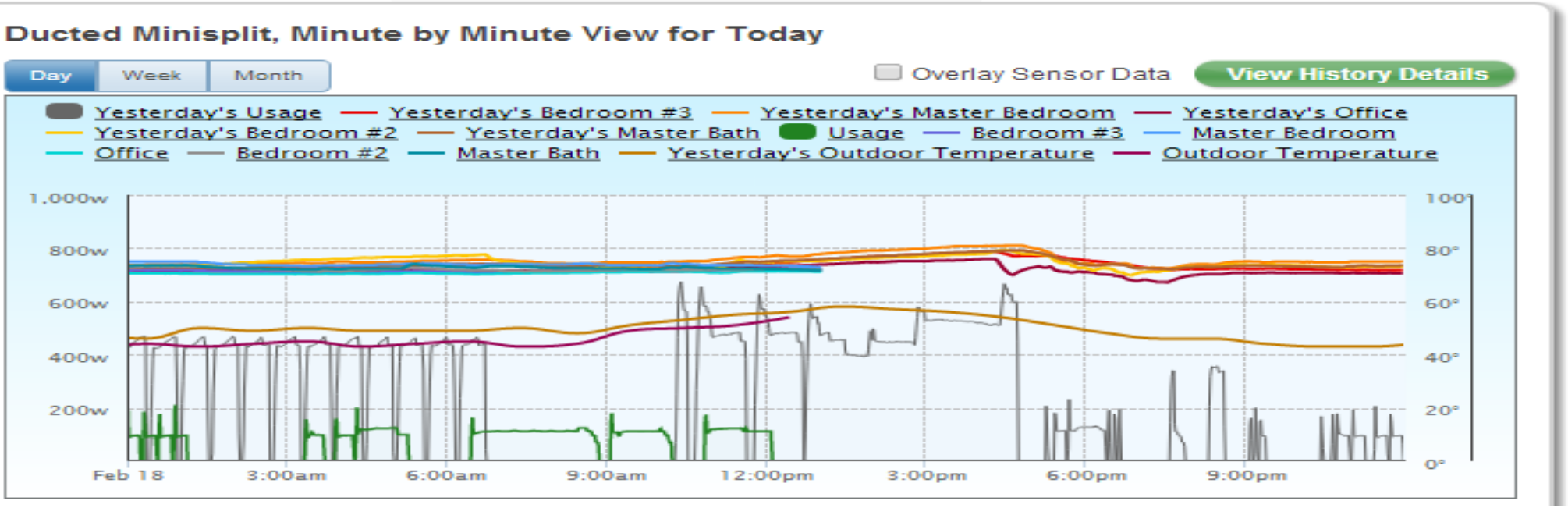
SIZING DUCTLESS HEAT PUMPS



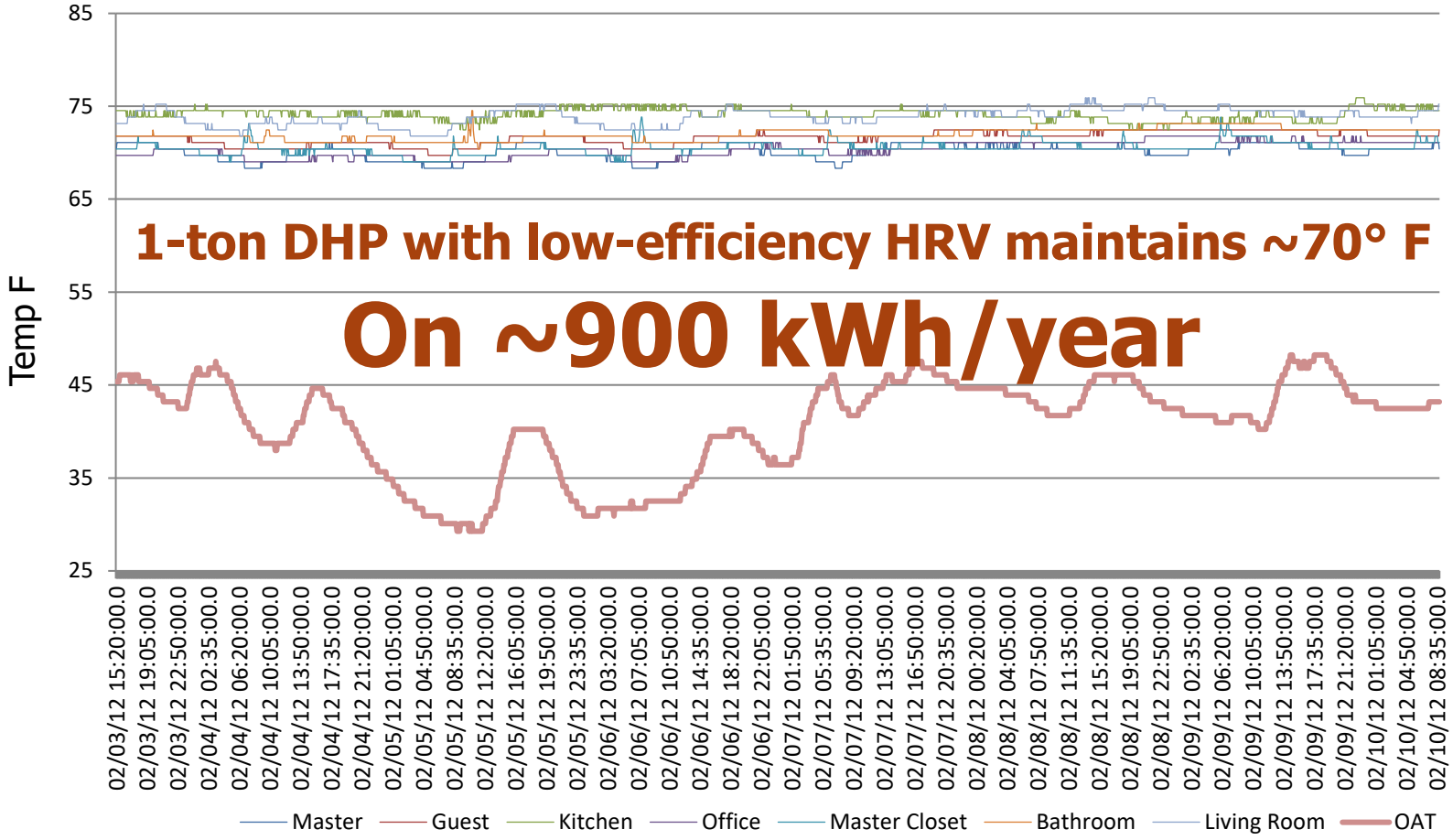
SIZING DUCTLESS HEAT PUMPS







ROOM TEMPS IN LOW-LOAD HOME

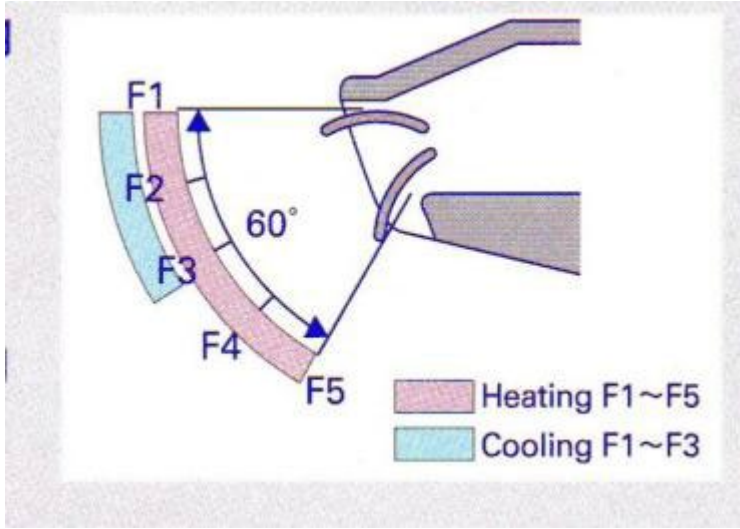


House has low UA. Very tight. 12K ductless heat pump and low-efficiency ERV. About 900 kWh/year for space heat.

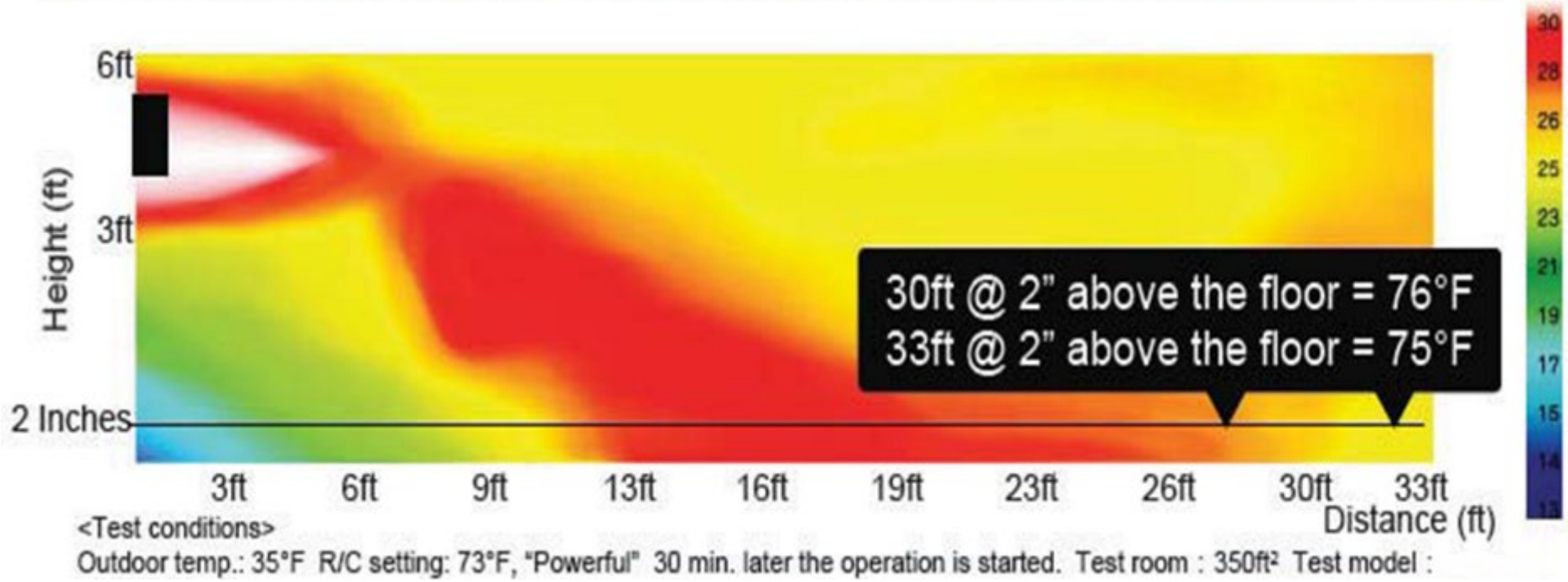
Sizing DHPs also Means Sizing and Placing of that Really Cool Diffuser

1. Let the flow go. Don’t block the indoor unit: no close walls, beds, etc.

2. Try to align larger units with central hallways.



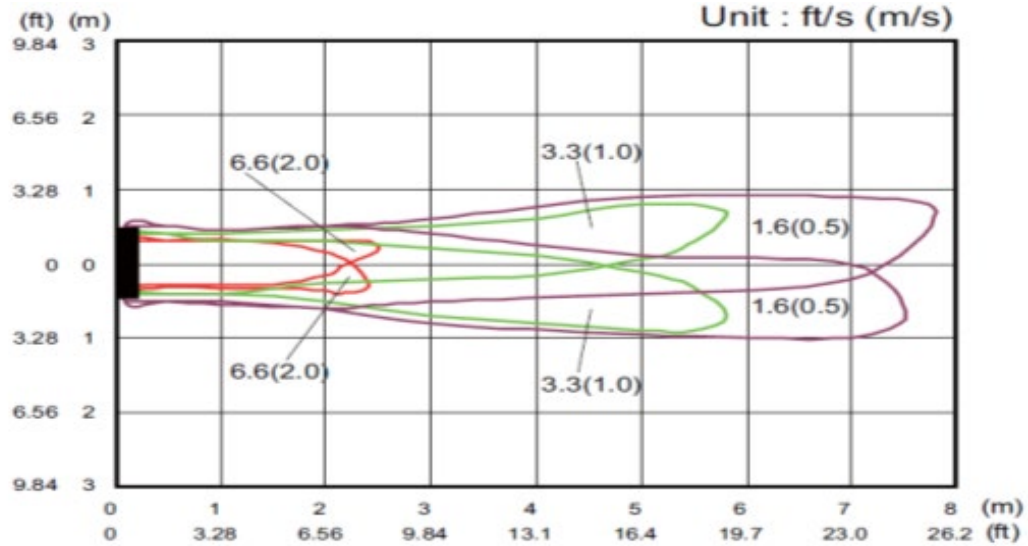
Effective Air Throw & Temperature Distribution for Larger Rooms



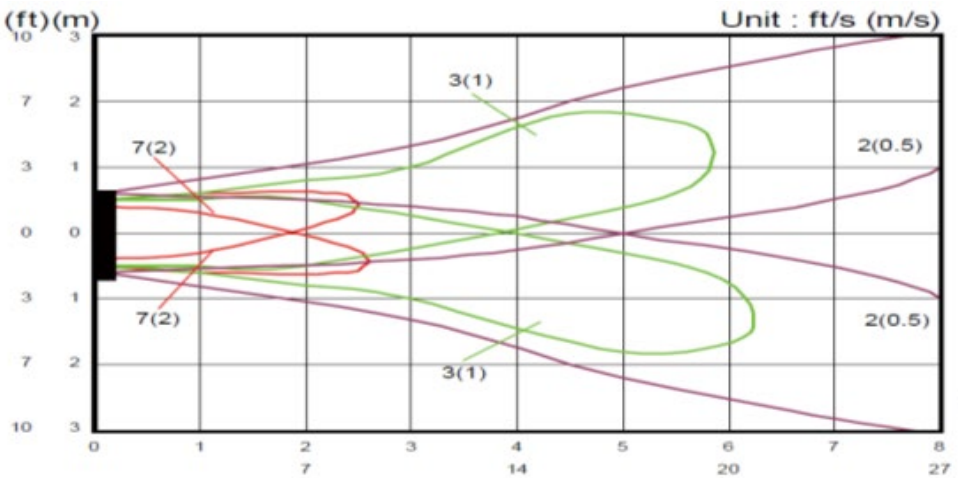
<Test conditions>

Outdoor temp.: 35°F R/C setting: 73°F, "Powerful" 30 min. later the operation is started. Test room : 350ft² Test model :

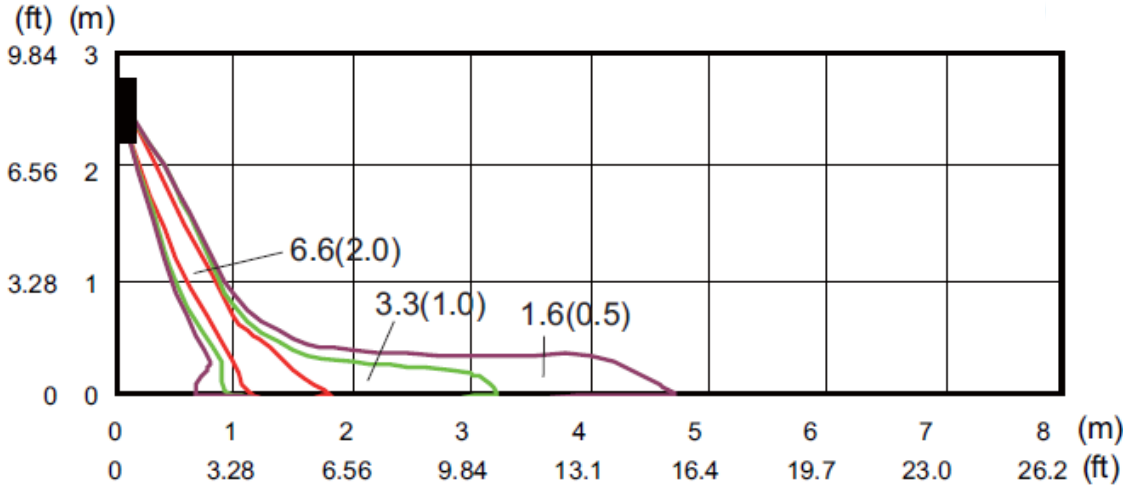
Model: ASU9RLS, ASU12RLS



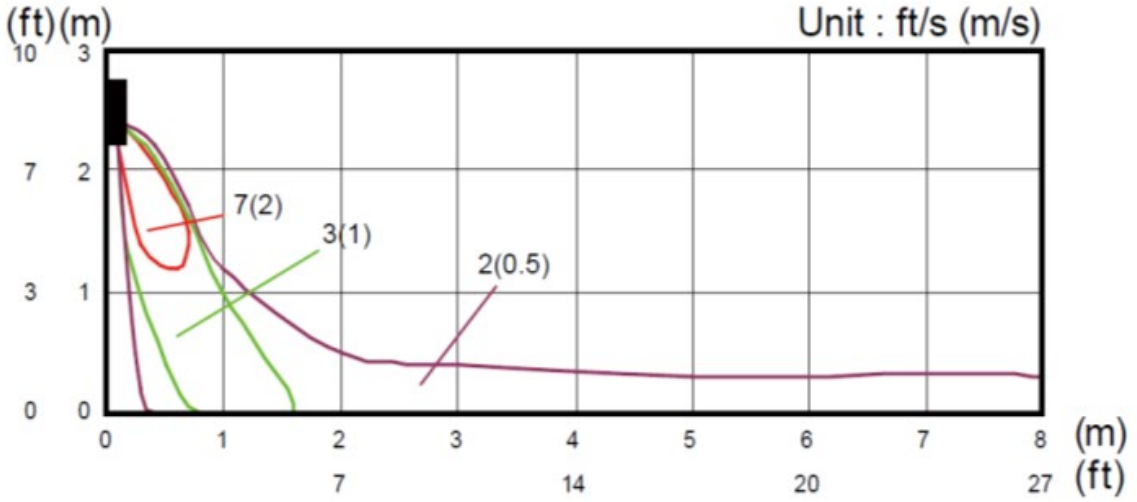
Model: ASU24RLF



Model: ASU9RLS, ASU12RLS



Model: ASU24RLF



When In Snow Country……

Homeowner Education

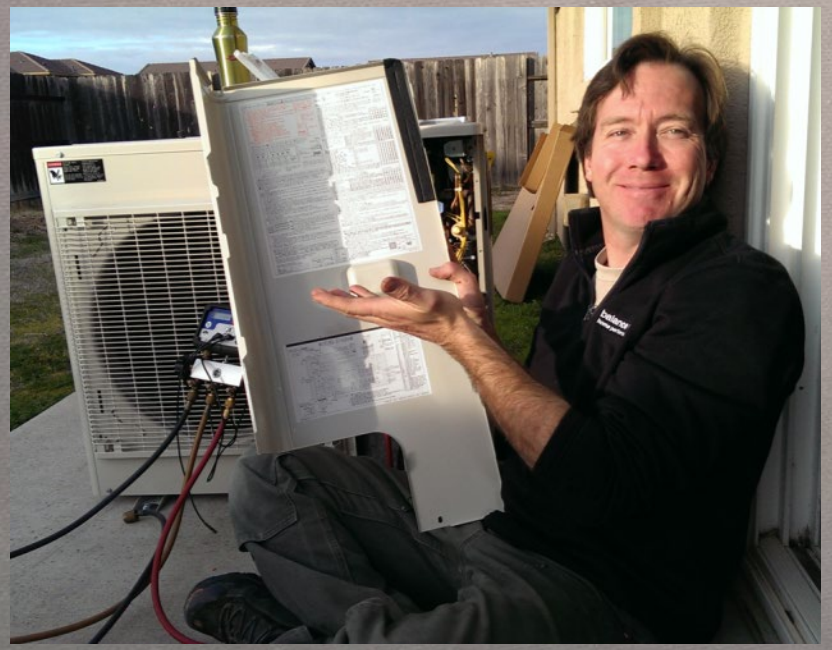
- Leave interior doors open
- Clean filters
- Don’t make big changes in the set points
- Don’t use the Auto Setting
- Explain the hieroglyphics
- The best system in the world does nothing if it isn’t used properly—Homeowners must be educated on the operation of systems in their homes

Dan Perunko
Balance Point Home Performance

U.S. DEPARTMENT OF ENERGY

www.balancepointhp.com

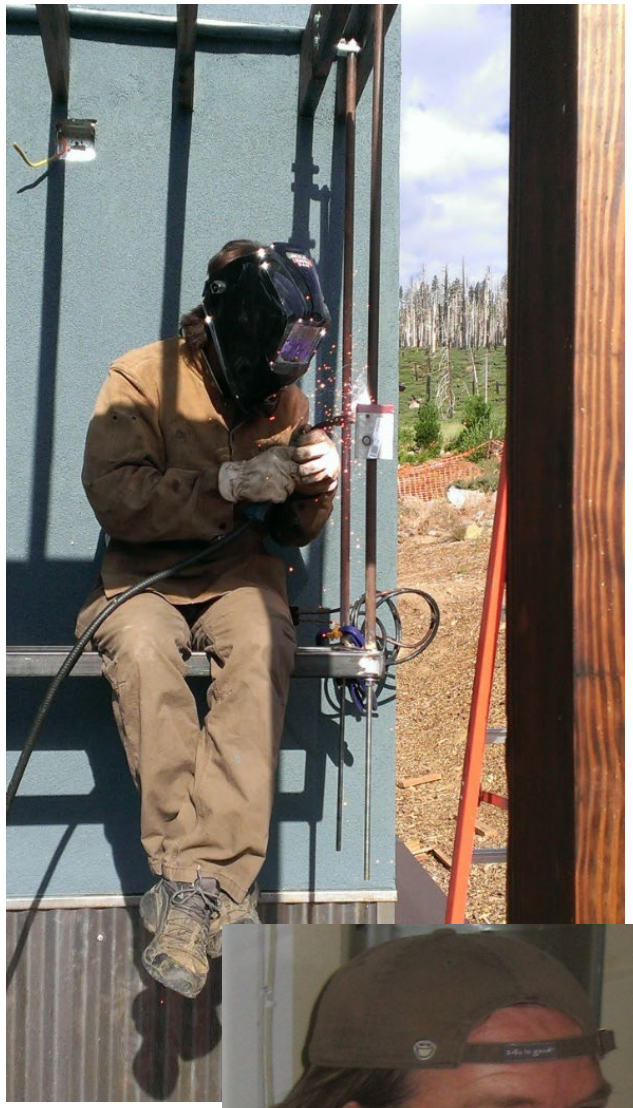
balance point
home performance

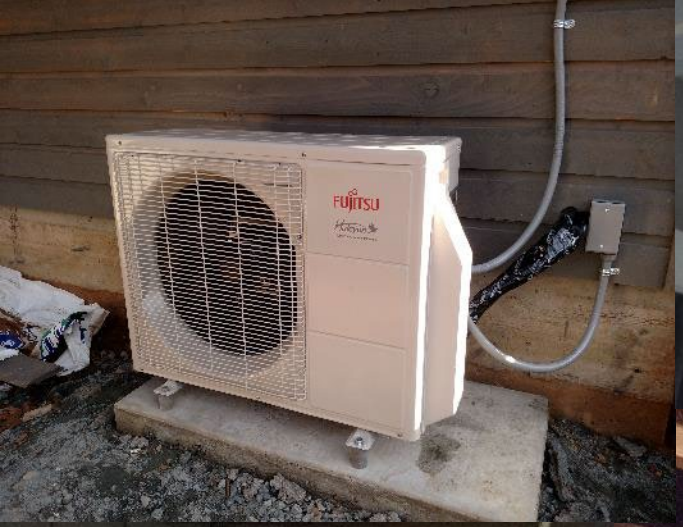


530-477-0695
Dan@balancepointhp.com

Construction, Consulting, Training


3M
N95




FUJITSU






SolarCity



APN: 038/275/041
PERMIT NO. 215242
NO SMOKING


WILLIAMS
SCOTSMAN
800.782.1500
United
HEAD TOILETS


SANI-HUT

Remarkably Unsophisticated

Inaccurate

When you turn on a water faucet you expect water to only come out of that specific faucet. If water poured from every faucet in your home, you'd be wasting water, but that's exactly what ducted home systems do while wasting energy.

Potentially Harmful

Ductless units are the most efficient and least expensive option

No argument there

We install them as part of a whole house system

There are two problems with the description of this workshop

Building Enclosures are typically much worse than the statement implies

- Most buildings experience significantly varied load from room to room.
  - The unconditioned rooms will deviate significantly from the conditioned portions of the home. (after ductless install)
- Many buildings will accumulate moisture within the structure and develop various failures if left unconditioned.
- Most buildings can be operated at significantly lower loads, and power consumption if building enclosures are evaluated and improved.

Problem 1

Ductless units generally can’t meet all the functions of a ducted system

- They provide very little useful filtration
- They primarily condition the portion of the home they can “see”
    - Hot and cold rooms are a common complaint among customers seeking HVAC upgrades
    - This includes both temperature control and moisture management for humid climates

How in the face of the Pandemic can we market a system that negatively impacts the air quality in a home by using bad analogies to undermine systems that can be used to manage indoor air quality?

Problem 2

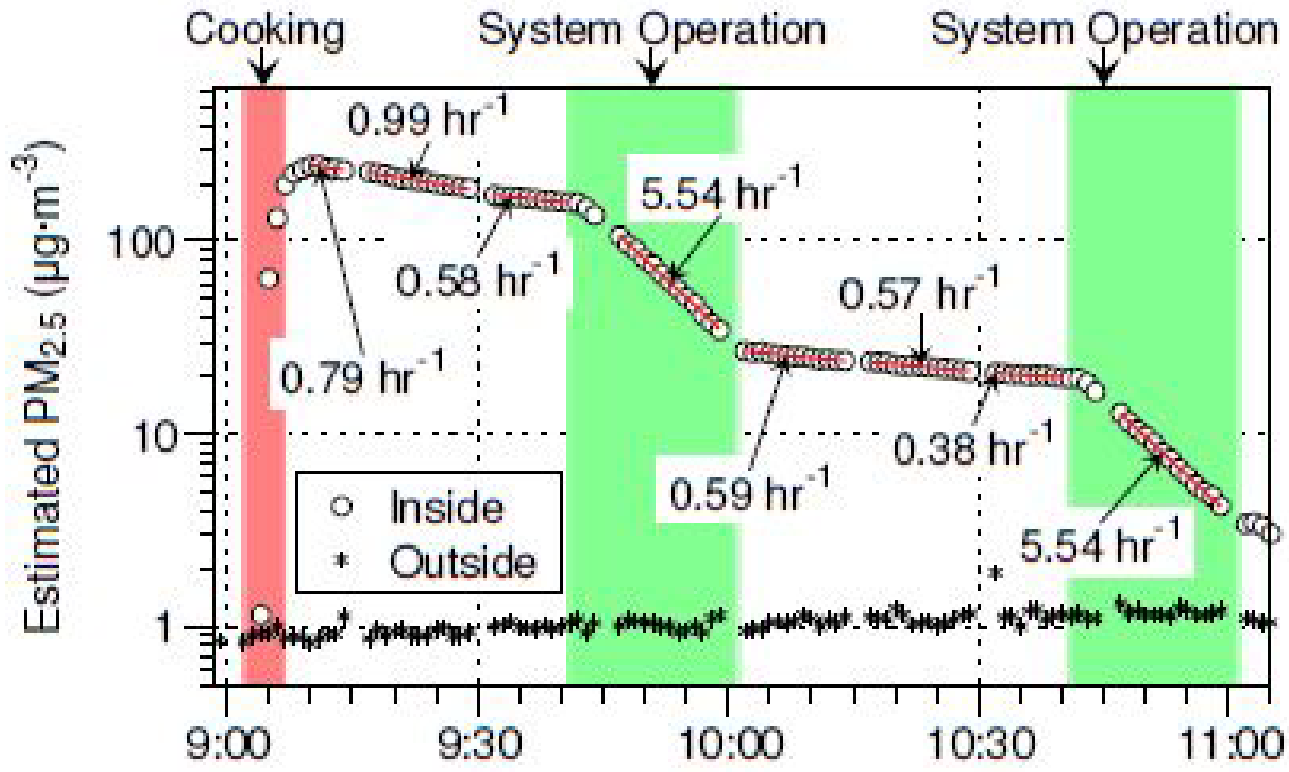


Figure 3.35. Time series of estimated $PM_{2.5}$ concentration calculated from size-resolved particle number concentrations during cooking experiment with System D on July 16, 2014.
Refer to Methods section for details on this calculation. Fitted decay rates during each period reflect sum of all particle transformation and removal mechanisms including growth, ventilation, deposition and filtration.

https://www.arb.ca.gov/research/single-project.php?row_id=65080

None of that is what I really wanted to talk about.

1. Refrigerant Leakage is Rampant

2. Load Calculations and proper equipment sizing still matter for variable capacity units. Think about part load efficiency

3. Protect the building Enclosure during mechanical installation

Refrigerant Leakage

- What percentage of new systems leak?
- Accidentally leaking systems are not illegal, not tracked and selling refrigerant is very profitable
- Many technicians are trained to ineffective standards for line set building and testing. Many know the steps but don’t really have a standard for what passes or fails
- De minimus release is legal

One technician x 1oz R410A per service call x 5 service calls per day x 5 days a week =

1.63 tons of carbon equivalent -R410a

(1 oz R410 x 5 jobs x 5 days x 2088 lbs carbon eq ÷ 2000lbs per ton = 1.63 tons)

(.529 tons of carbon equivalent – R32)

Exceptionally Good Practice, one tech per week

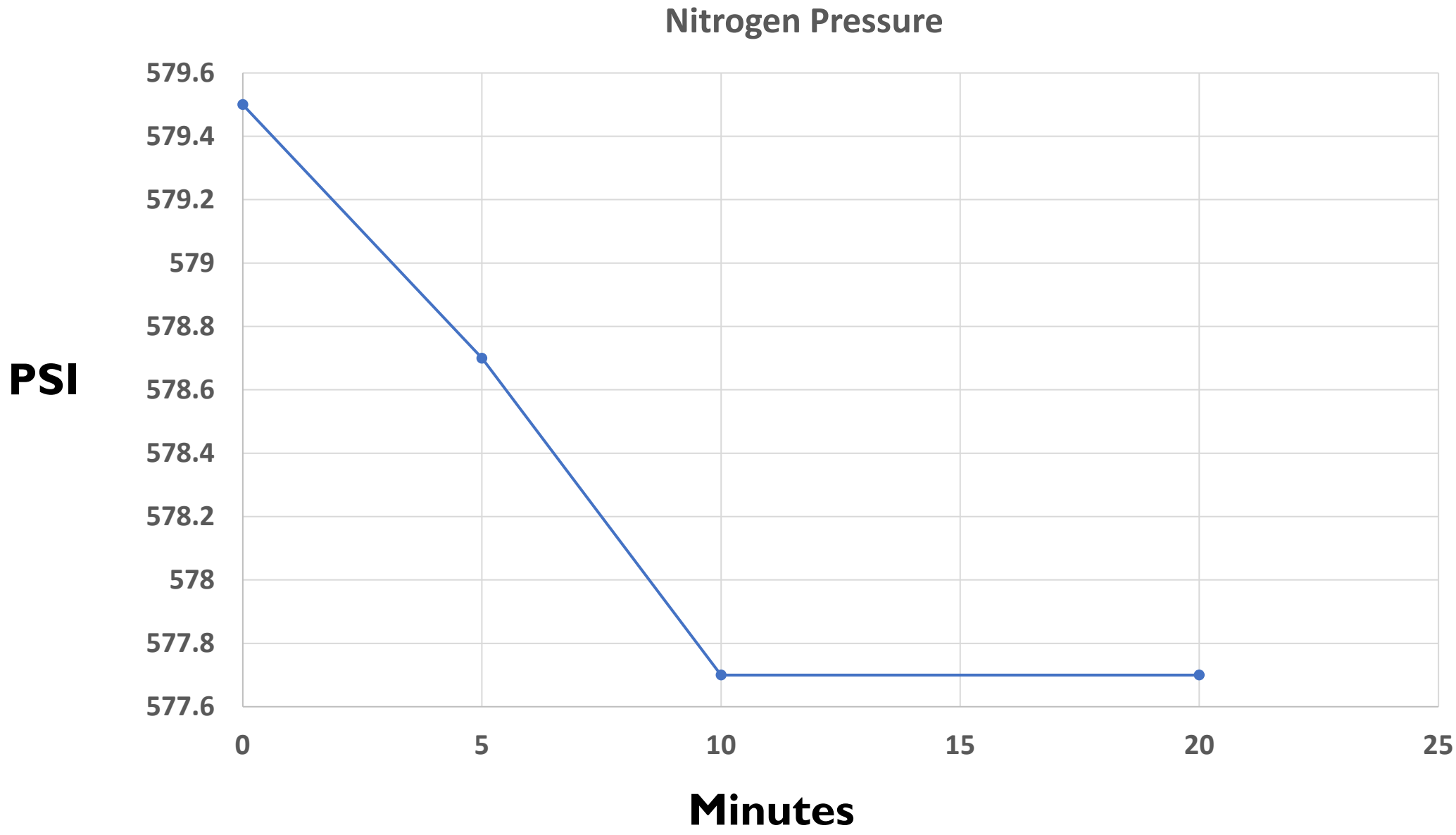
The solar Array on my home, has offset 109,086 pounds of carbon

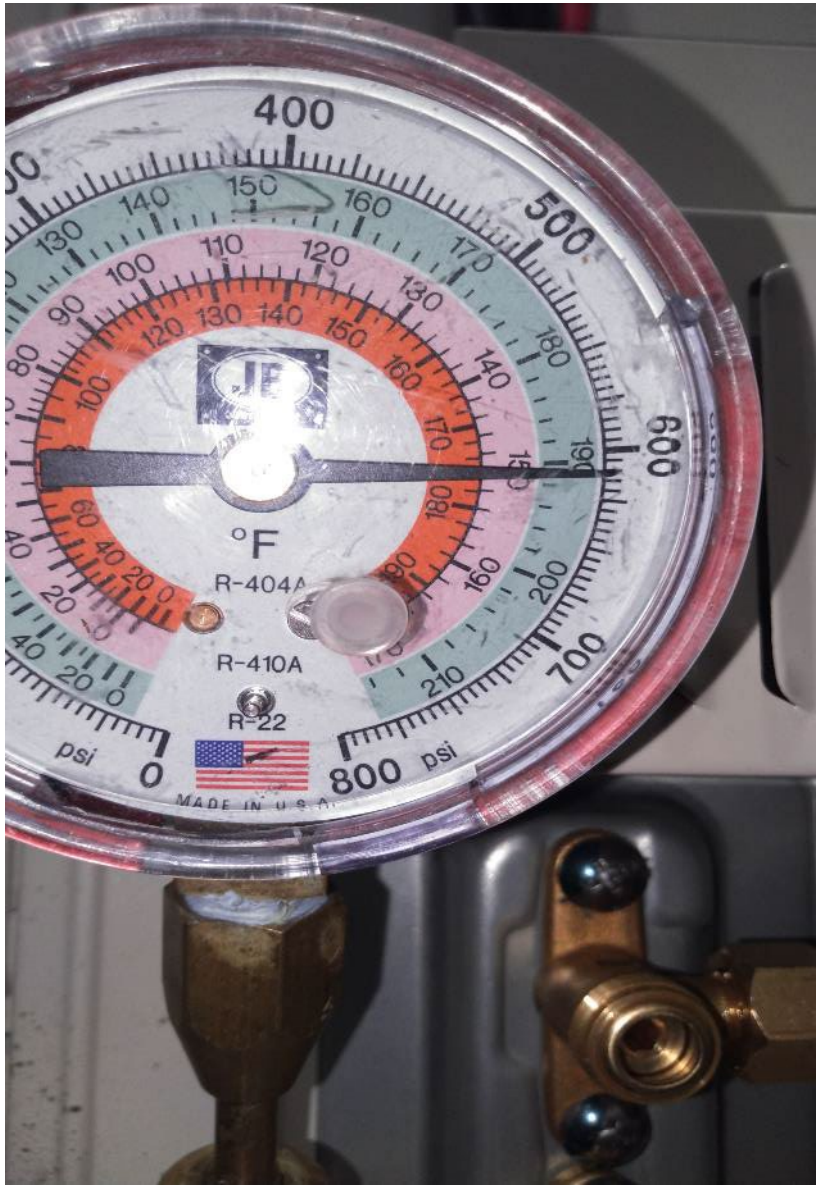
109086 lbs carbon ÷ 2088 lbs carbon per lb R410A =

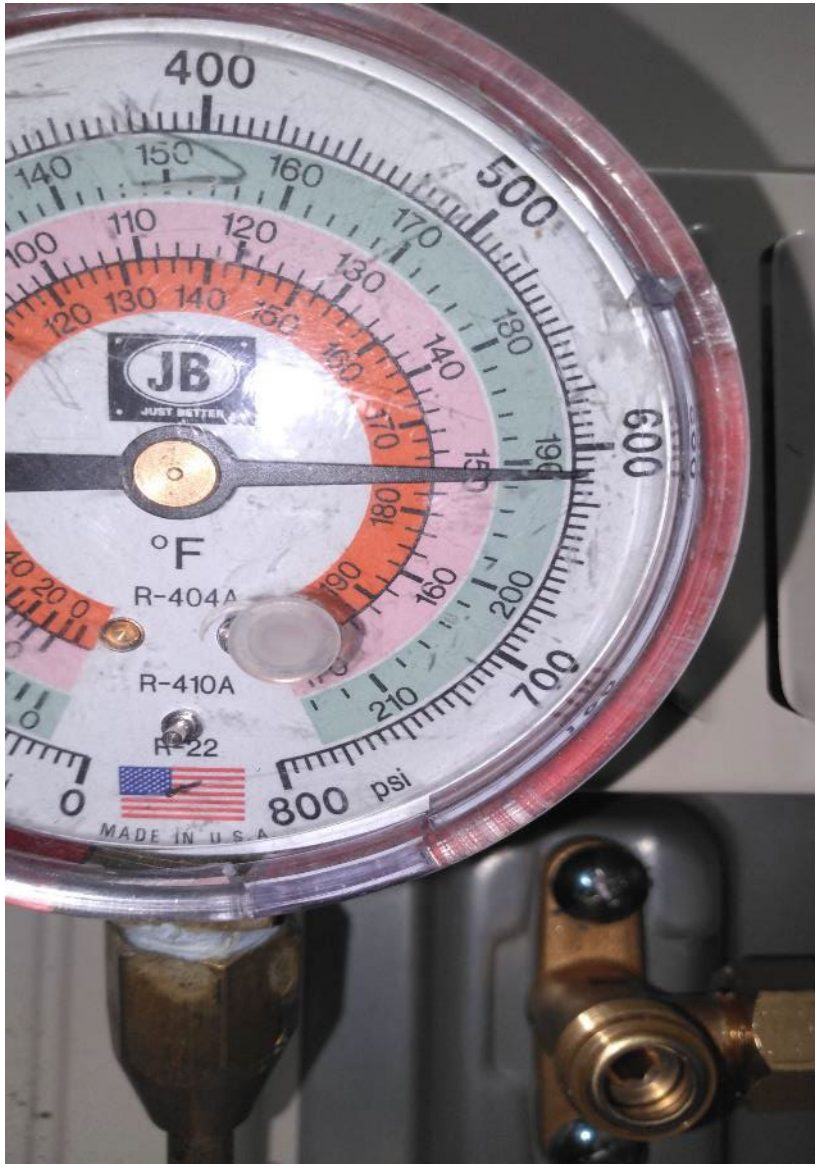
52 lbs of R410A

In other words, if six three ton heat pumps are allowed to leak completely. It would be as if my Solar Array was never installed

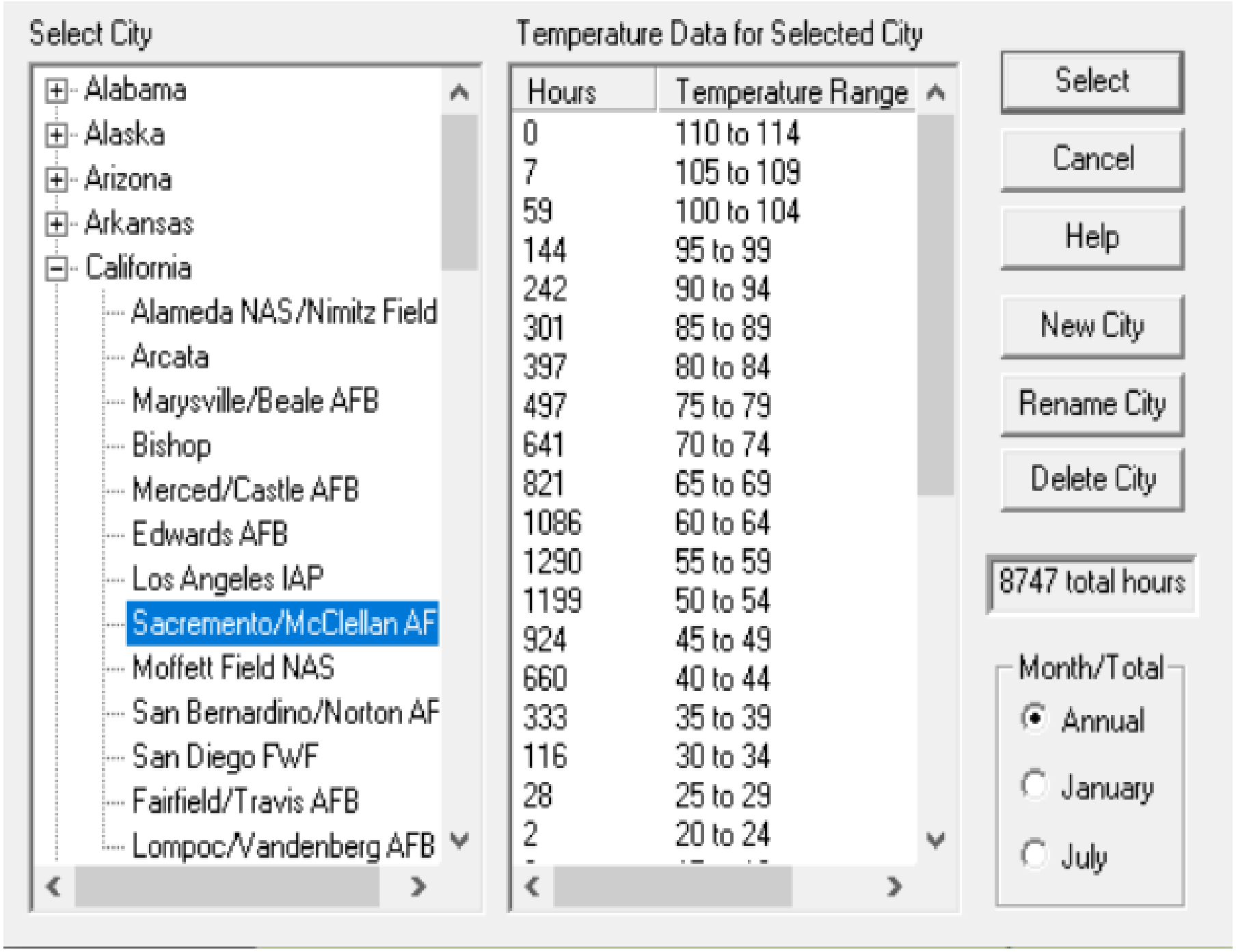

Rigorous standards for practice are needed as we dramatically raise the volume of refrigerant we introduce to the built environment.


Nitrogen Pressure
PSI
579.6
579.4
579.2
579
578.8
578.6
578.4
578.2
578
577.8
577.6
0
5
10
15
20
25
Minutes


400
500
600
700
800 psi
0
°F
R-404A
R-410A
R-22
MADE IN U.S.A.

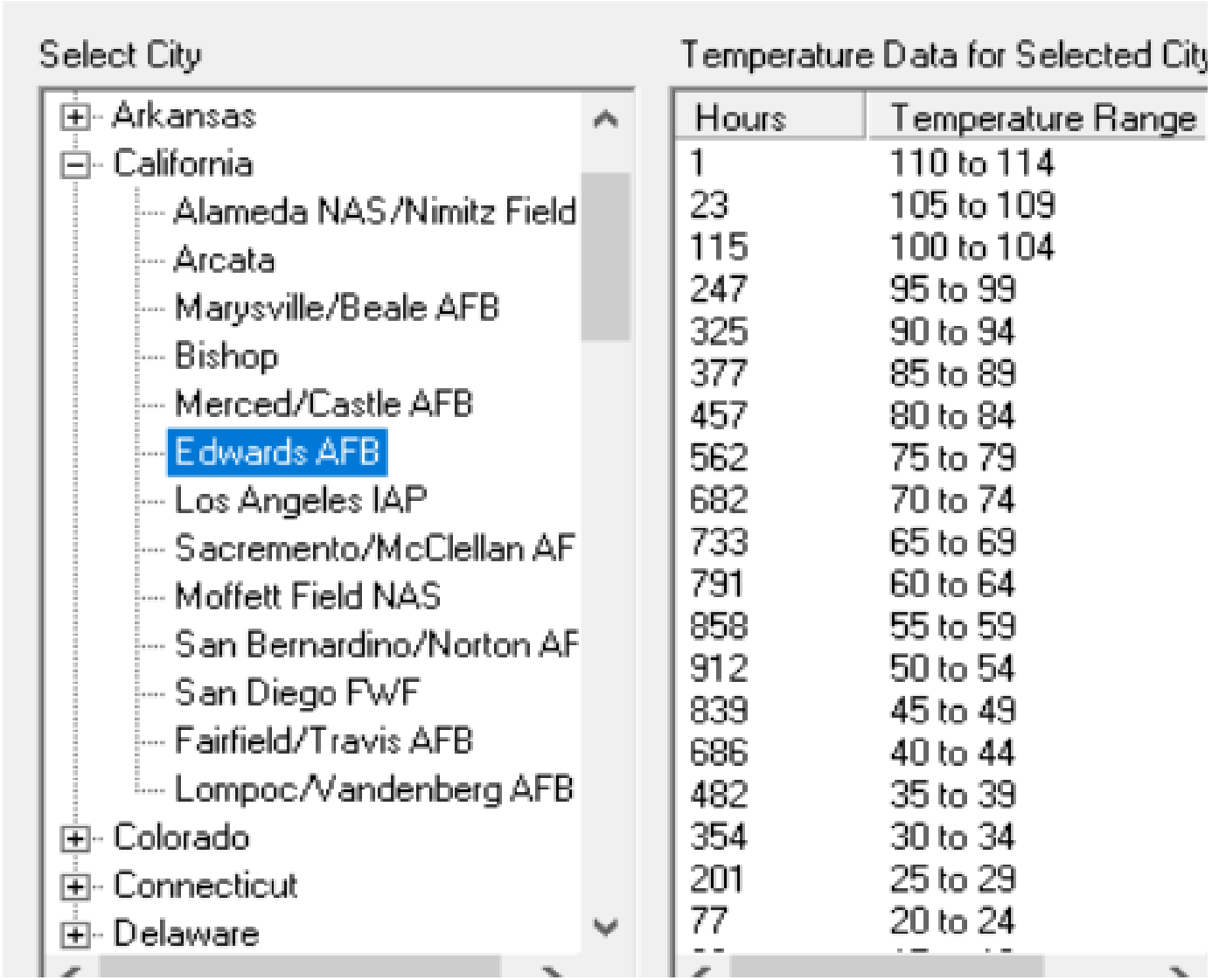

400
500
600
700
800 psi
0
JB
°F
R-404A
R-410A
R-22
MADE IN U.S.A.

Load Calculations, Equipment Sizing and Part Load Conditions



Part Load is most of the load

Bin Data City Selection



Part Load is most of the load

General Features

- •Refrigerant Type R410A.
- •Human Sensor
- •Wired and wireless remote controllers
- •Double swing automatic
- •Automatic airflow adjustment
- •Low noise mode
- •Powerful mode
- •5- Years Parts, 7-Years Compressor Warranty (See Warranty Statement for details)
- •Program timer
- •Weekly timer

Model Information

Outdoor	AOU9RLS3
Indoor	ASU9RLS3

Electrical

208/230V AC 1ph-60Hz

Available Voltage Range	208/230 +/- 10%
Minimum Circuit Ampacity	13.4 A
Max Fuse Size	15A
Max Starting Current	3.3 A

Input Power

Cooling	0.5 kW
Heating	0.66 kW

Running Current

Cooling	2.5 A
Heating	3.3 A

Capacity

Nominal Cooling	9,000 Btu
Min-Max Cooling	3,100–12,000 Btu
Nominal Heating	12,000 Btu
Min-Max Heating	3,100-22,000 Btu

Compressor

Rotary (inv x1)

Motor Output	850 W
Refrigerant	R410a

Operation Temperature Range

Cooling	14°F to 115°F (46°C - -10°C)
Heating	-5°F to 75°F (24°C - -21°C)

Efficiency

SEER	33
EER (cooling)	5.28 kW/kW
COP (heating)	5.33 kW/kW / 18.2 Btu/hkW
HSPF (heating)	14.2 Btu/hW

Enclosure

Condenser	
Material	Painted galvanized steel
Color	Beige (10 YR 7.5/1.0 NN)
Evaporator	
Material	Polystyrene
Color	White (Approximate color of Munsell 5PB 9.25/0.5)

Sound Pressure Level

Outdoor	42 dB(A)
Indoor	42 dB(A)

Dimensions

H x W x D	
Outdoor in. (mm)	24-1/2 (620) x 31-1/8 (790) x 11-7/16 (290)
Indoor in. (mm)	11-5/8 (295) x 37 (940) x 10-5/8 (270)

Connection Pipe

6. CAPACITY TABLE

6-1. COOLING CAPACITY

■ MODEL: ASU9RLS3

AFR	489

		Indoor temperature																	
	°FDB	64			70			75			80			85			90		
	°FWB	54			60			63			67			71			73		
Outdoor temperature	°FDB	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP
	15	8.33	8.06	0.19	9.29	8.11	0.19	10.25	8.87	0.20	10.57	9.53	0.20	11.17	9.50	0.20	11.81	10.07	0.21
	23	8.16	7.88	0.22	9.09	7.91	0.22	10.03	8.65	0.23	10.35	9.31	0.22	10.94	9.28	0.22	11.56	9.91	0.23
	32	7.99	7.69	0.22	8.90	7.75	0.23	9.81	8.45	0.24	10.13	9.16	0.23	10.70	9.09	0.23	11.32	9.68	0.24
	41	7.81	7.58	0.24	8.71	7.61	0.24	9.60	8.28	0.25	9.90	8.97	0.24	10.47	8.90	0.24	11.07	9.50	0.25
	50	7.64	7.36	0.22	8.51	7.41	0.22	9.38	8.07	0.24	9.68	8.76	0.23	10.24	8.70	0.23	10.83	9.26	0.24
	59	7.47	7.24	0.27	8.32	7.27	0.27	9.16	7.91	0.28	9.46	8.57	0.28	10.01	8.51	0.28	10.58	9.09	0.28
	67	8.42	8.15	0.34	9.38	8.18	0.35	10.33	8.94	0.36	10.67	9.63	0.36	11.28	9.59	0.36	11.93	10.18	0.37
	77	8.01	7.74	0.39	8.93	7.77	0.39	9.85	8.49	0.40	10.16	9.15	0.40	10.74	9.11	0.41	11.35	9.73	0.41
	87	7.57	7.29	0.44	8.45	7.36	0.44	9.31	8.01	0.45	9.58	8.67	0.45	10.16	8.63	0.46	10.74	9.18	0.46
	95	7.09	6.88	0.48	7.91	6.91	0.49	8.73	7.53	0.50	9.00	8.15	0.50	9.55	8.12	0.51	10.06	8.63	0.51
	104	6.00	5.67	0.45	6.68	6.16	0.46	7.36	6.71	0.46	7.60	7.26	0.46	8.05	7.22	0.47	8.52	7.70	0.47
	115	5.52	5.33	0.45	6.17	5.71	0.46	6.78	6.22	0.46	6.99	6.74	0.46	7.43	6.71	0.47	7.84	7.15	0.47

AFR : Air Flow Rate (CFM)
TC : Total Capacity (kBtu/h)
SHC : Sensible Heat Capacity (kBtu/h)
IP : Input Power (kW)

Much better we need expanded data!!

Fujitsu expanded data table from the Design and Technical Manual

MITSUBISHI ELECTRIC
Changes for the Better

M-SERIES

SUBMITTAL DATA: MSZ-GL09NA-U1 & MUZ-GL09NAH-U2

9,000 BTU/H WALL-MOUNTED HEAT PUMP SYSTEM

Job Name:	Location:	Date:
Purchaser:	Engineer:	
Submitted to:	For ☐Reference ☐Approval ☐Construction	
System Designation:	Schedule No.:	

SPECIFICATIONS:

Rated Conditions (Capacity / Input)		
Cooling[1]	Btu/h / W	9,000 / 585
Heating at 47° F[2]	Btu/h / W	10,900 / 720

Capacity Range		Minimum	Maximum
Cooling[1]	Btu/h	3,600	12,200
Heating at 47° F[2]	Btu/h	4,500	14,100
Heating at 17° F[3]	Btu/h	-	9,400
Heating at 5° F[4]	Btu/h	-	7,600

[1] Cooling | Indoor: 80° F(27° C)DB / 67° F(19° C)WB; Outdoor: 95° F(35° C)DB / 75° F(24° C)WB˚
[2] Heating at 47°F | Indoor: 70° F (21° C)DB / 60° F (16° C)WB; Outdoor: 47° F (8° C)DB / 43° F (6° C)WB˚
[3] Heating at 17° F | Indoor: 70° F(21° C)DB / 60° F(16° C)WB; Outdoor: 17° F(-8° C)DB / 15° F(-9° C)WB˚
[4] Heating at 5° F | Indoor: 70° F (21° C)DB / 60° F(16° C)WB; Outdoor: 5° F(-15° C) DB / 5° F(-15° C)WB
˚ Rating Conditions per AHRI Standard:

Protect the building enclosure during mechanical installation


Protect the Building
Enclosure

balance point
home performance

Conclusions

We have the opportunity to make a large difference in the fate of our climate.

If we stick to unsophisticated, oversimplified easy to market options…

Our contribution to the future climate just might, make it worse.

DOE Health + Home Performance Infographic

- **WHO**: Res EE programs, partners (contractors+)
- **WHAT**: Visual aid, trusted source
- **WHERE**: IRL or digitally
- **WHY**: Most do not get link btw home, health & efficiency
- **CONTRACTORS:** Find qualified networks

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.

https://rpsc.energy.gov

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or future call topic ideas to:
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